MARYLAND
DEPARTMENT OF THE ENVIRONMENT

Summary of the DISCOVER-AQ Campaign and Incorporation of the Results into MDE's O_3 Conceptual Model

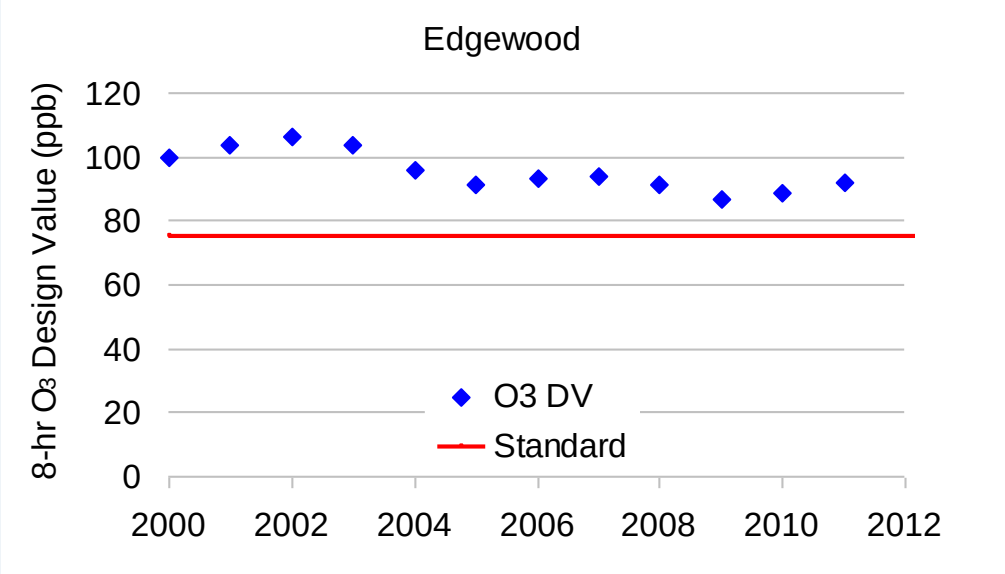
Jennifer Hains

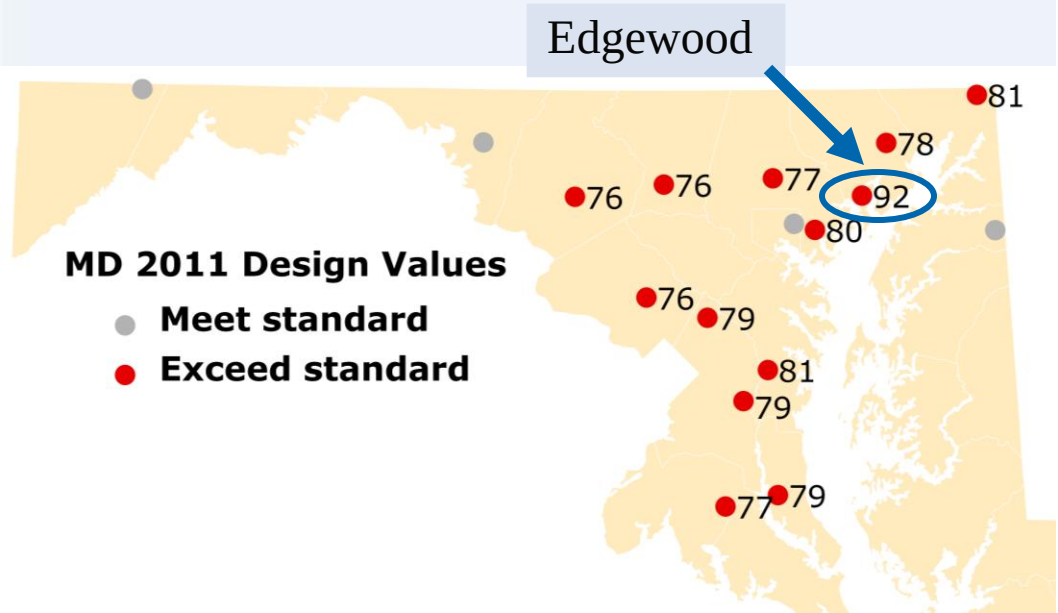
Maryland Department of the Environment

National Air Quality Conference – Ambient Monitoring

May 16, 2012

Introduction

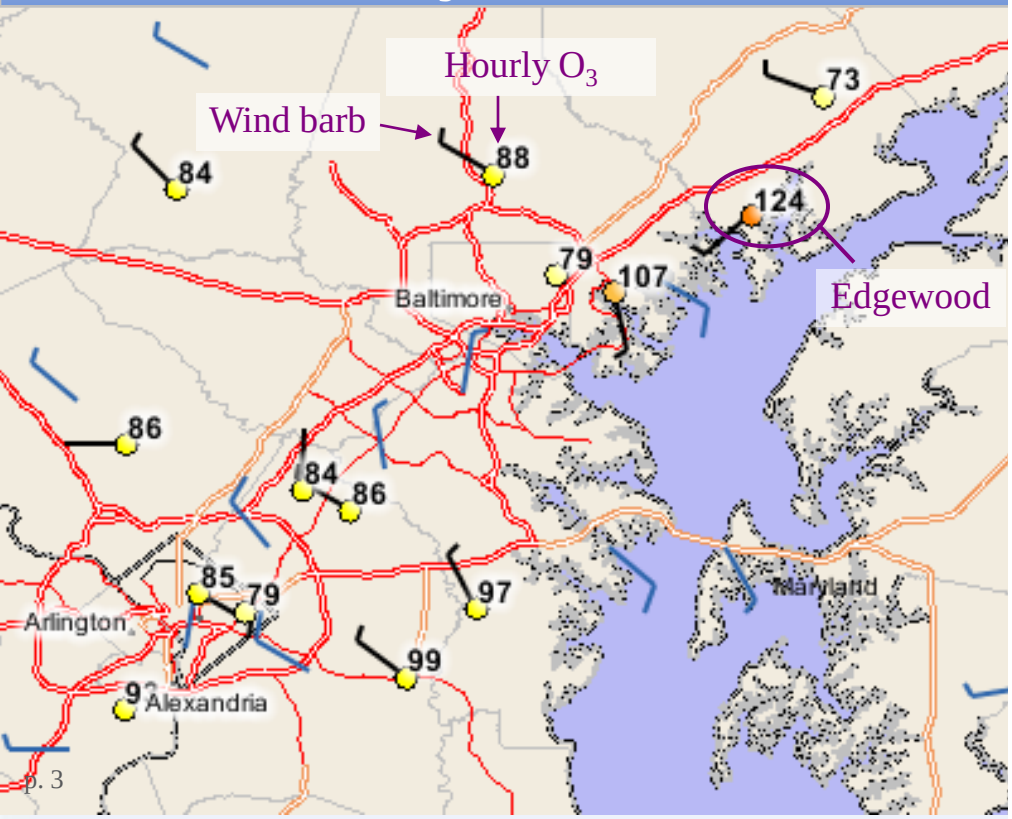




- O_3 conceptual model – Qualitative look at O_3 sources and transport patterns as well as effectiveness of control measures.
- Most sites in MD exceed the O_3 75 ppb NAAQS → Edgewood is the most problematic.
  - Downwind from Baltimore/Washington.
  - Nearby sources.
  - Westerly winds and bay breeze convergence zone traps pollution.
- We collaborate with nearby Universities to investigate O_3 events with aircraft and balloon launches.

The Edgewood Problem

Hourly O_3 on June 8, 2011

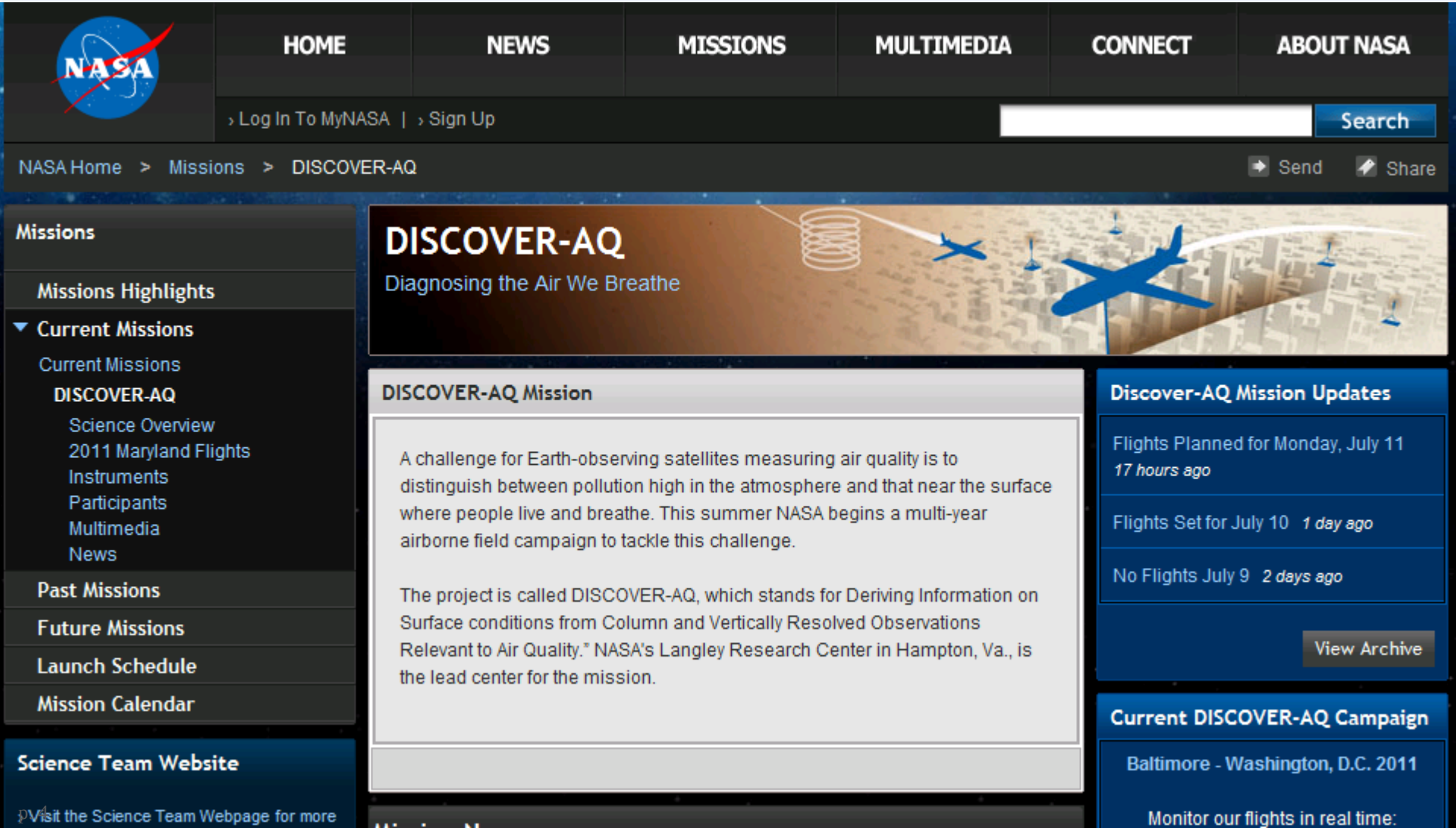


Source: AIRNow-Tech

- The Baltimore NAA continues to struggle with the 8-hour O_3 NAAQS.
  - Edgewood is the "troublesome monitor".
- In 2011 Edgewood reported 17 O_3 exceedance days.
- Edgewood influences:
  - Chesapeake Bay breeze - Caused by a sharp gradient between land and water temperatures.
  - Stagnation
  - Temperatures generally $\geq$ 90 F.
- DISCOVER-AQ provided multi-platform measurements to examine sources and transport of O_3.

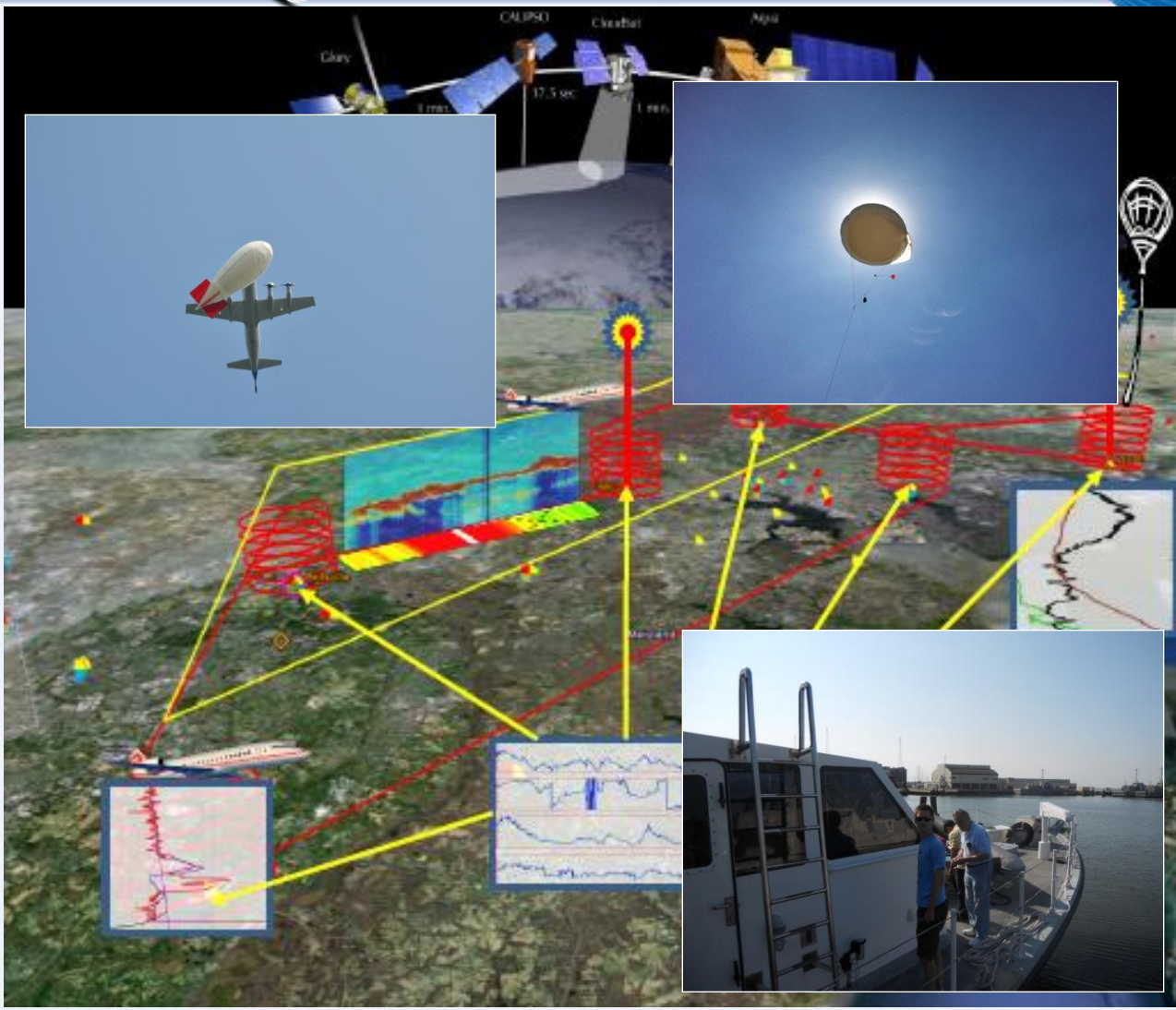
Deriving Information on Surface Conditions from COlumn and VERtically Resolved Observations Relevant to Air Quality

website



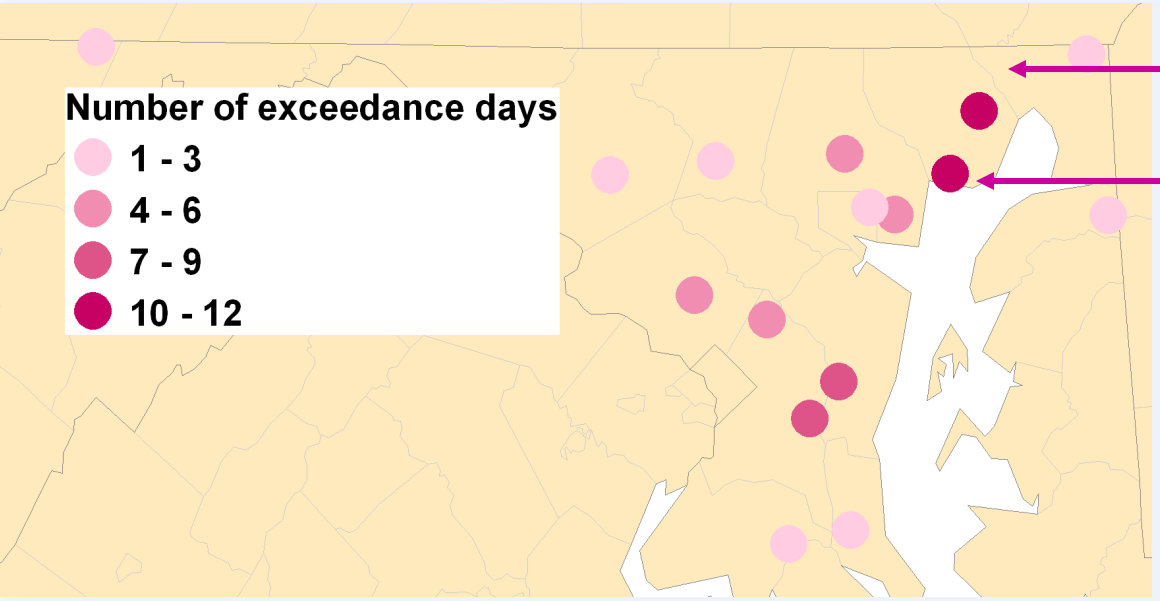
DISCOVER-AQ Measurements

- Sampling conducted during July 2011, with 16 exceedance days.
- Observations
  - 3 aircrafts – 254 spirals.
  - 6 surface sites
  - 4 aerosol lidars
  - 2 O_3 sonde locations
  - 1 tethered balloon
  - 1 ship

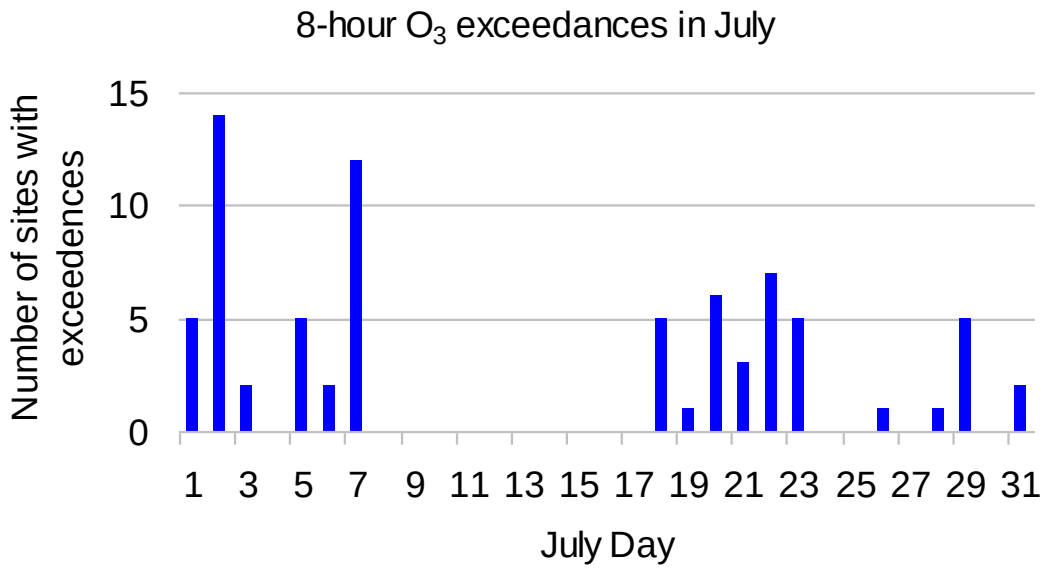


Courtesy: Jim Crawford, NASA

July O_3 summary

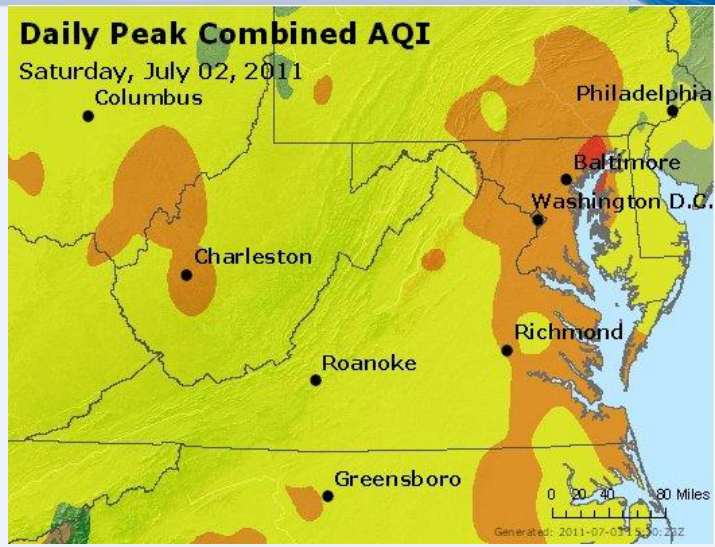


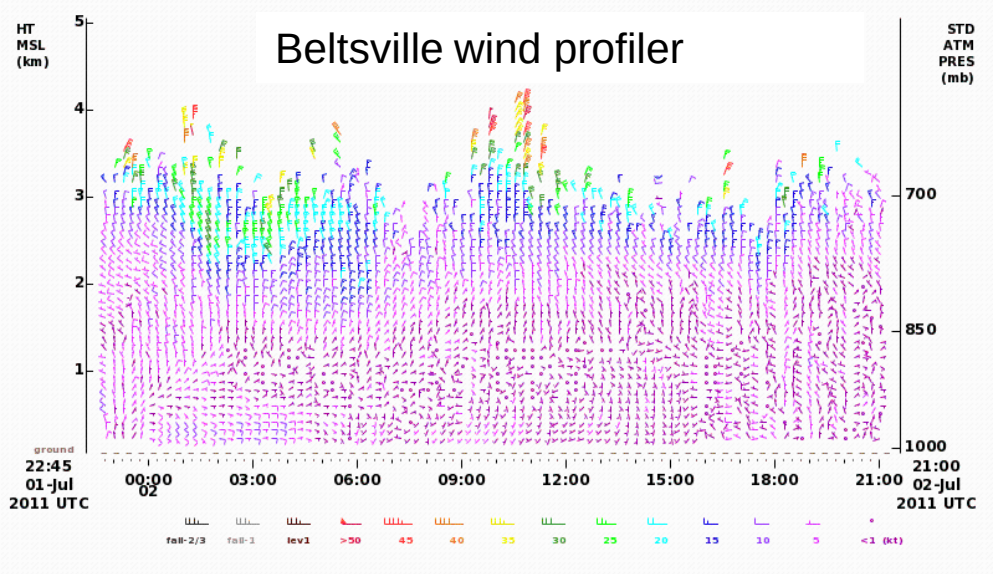
- In July Aldino and Edgewood had the most exceedance days (10 and 12).
- Edgewood had 3 code red days.
  - 8-hr avg. > 96 ppb
  - Examples: July 2 and 22.

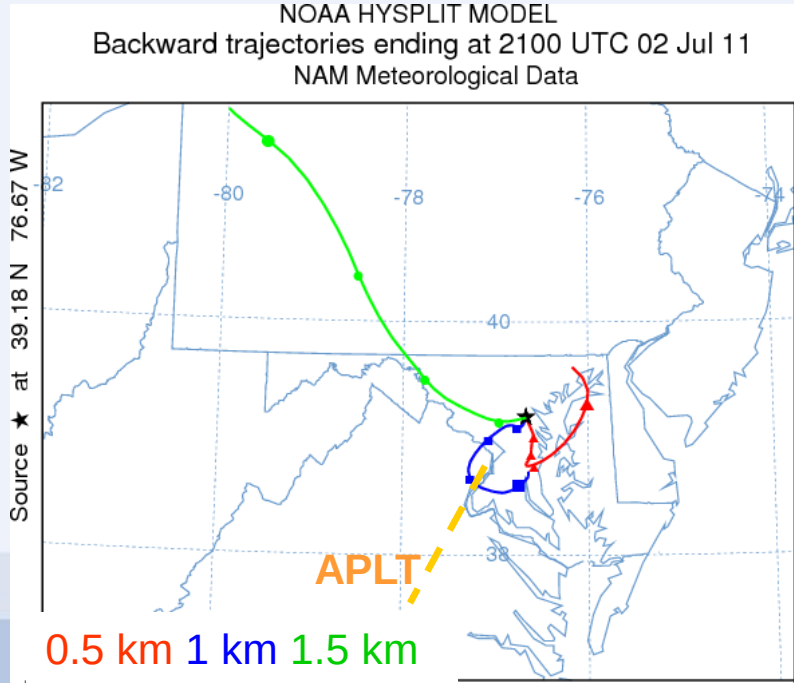


July 2, 2011

- Part of July 1-3 episode.
- Daily max 8-hour O_3 → 107 ppb at Edgewood.
- Contributors:
  - High pressure system.
  - Max. temperature @ BWI at 91 F.
  - Stagnant conditions throughout the day.
  - Appalachian Lee Side Trough (APLT).
  - Bay breeze.

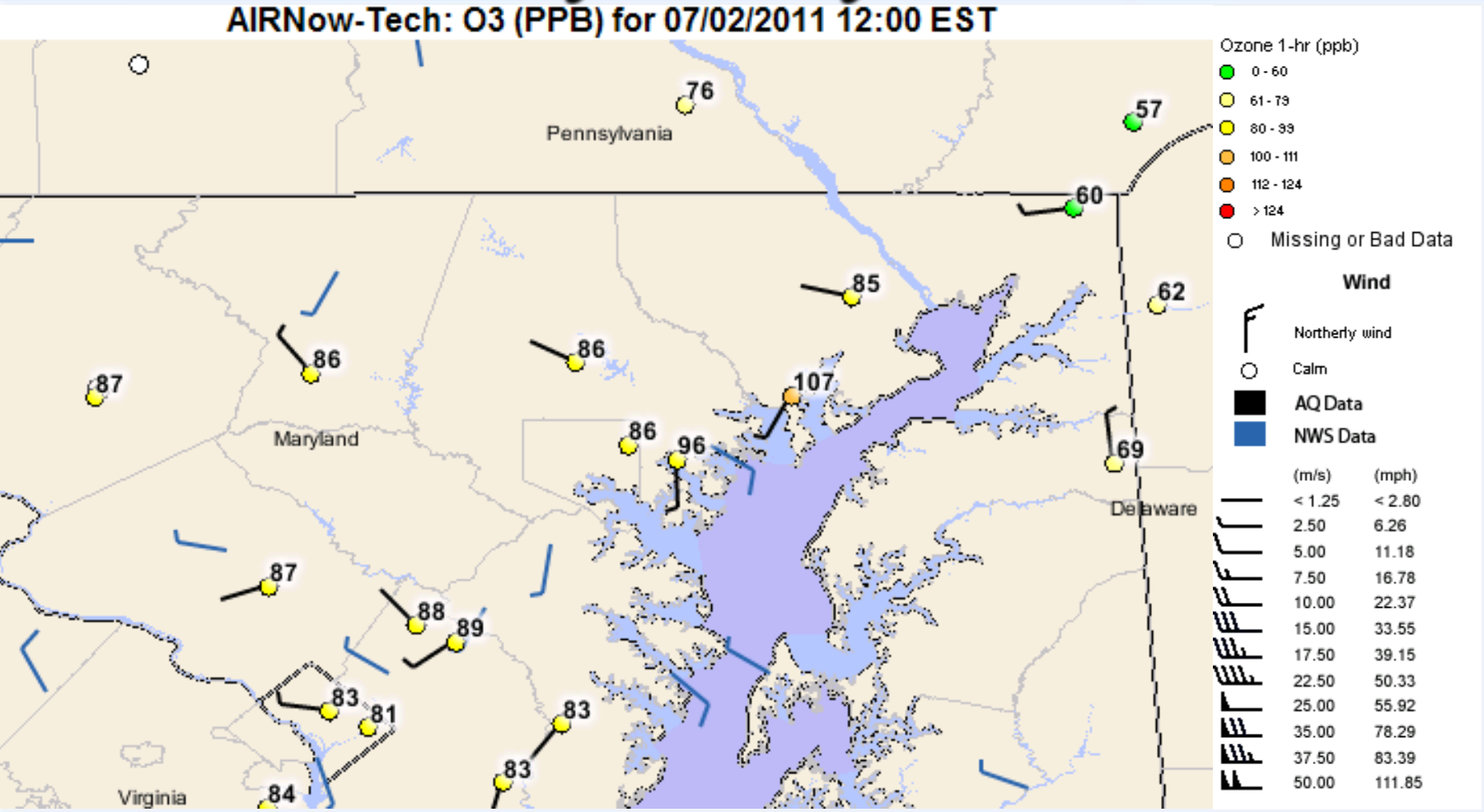






Sources: AIRNow, NOAA- ARL, NOAA MADIS, HU, PSU, Hysplit, Laura Landry-MDE

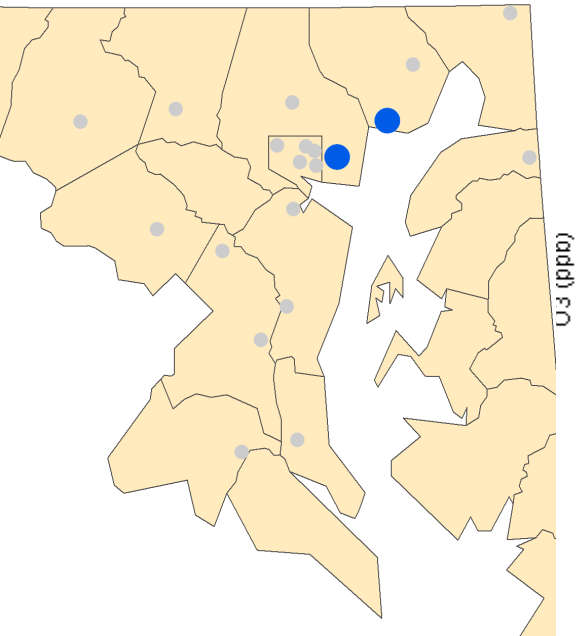
July 2 Bay Breeze

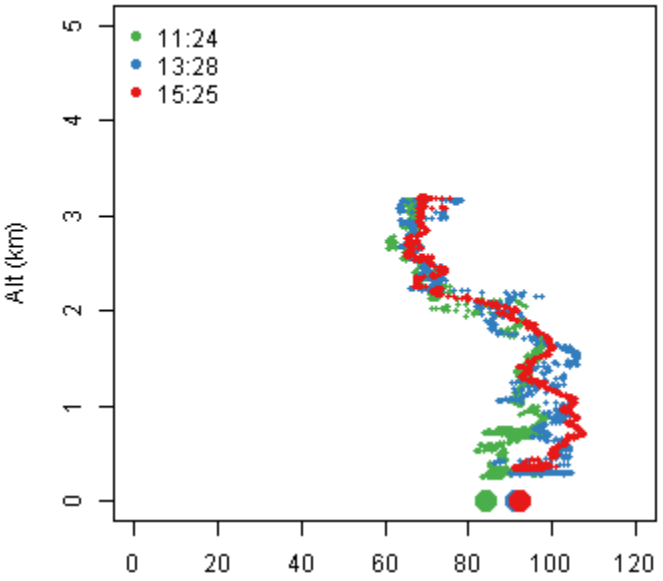


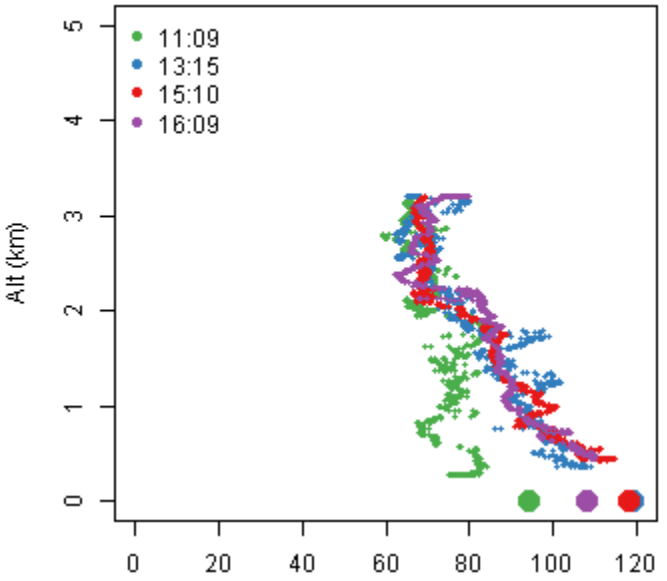
- Surface winds at Essex and Edgewood show onshore flow while winds at Padonia and Aldino show northwesterly winds.
- Sodar at Edgewood also shows onshore flow.

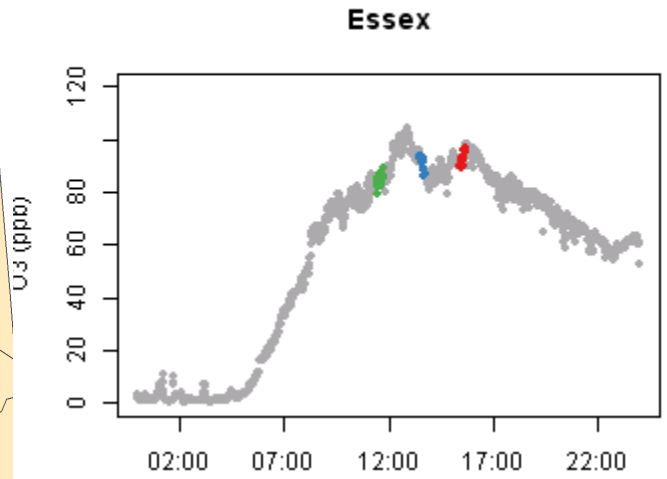
Bay breeze impacts Essex-Edgewood

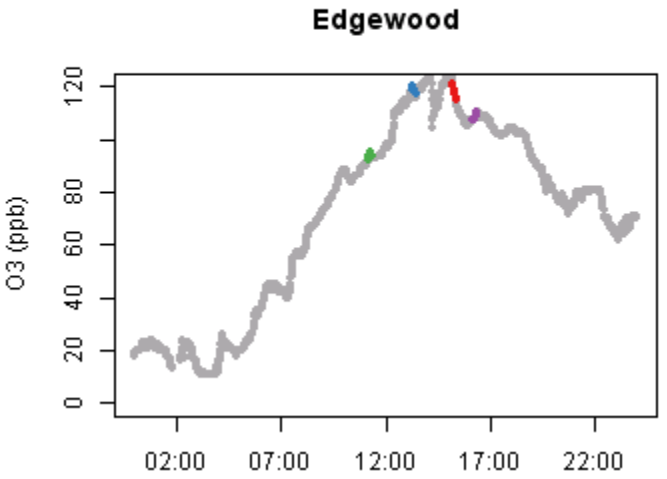
- Stagnation leads to high O_3 around the region.
- Bay breeze contributes to code red O_3 at Edgewood and code orange at Essex.









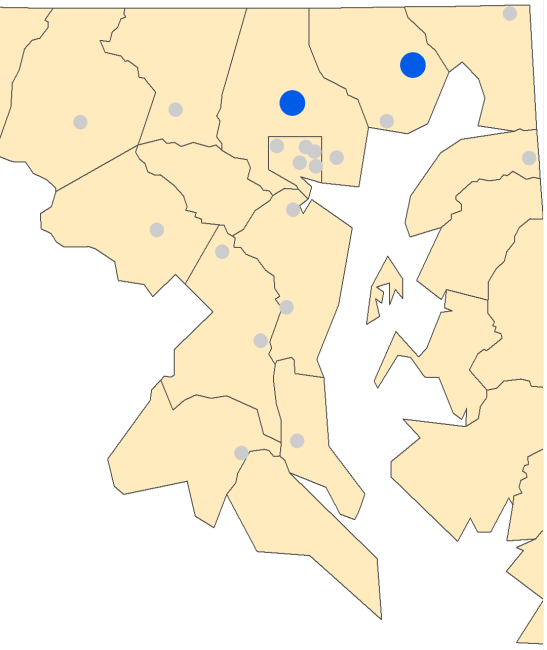


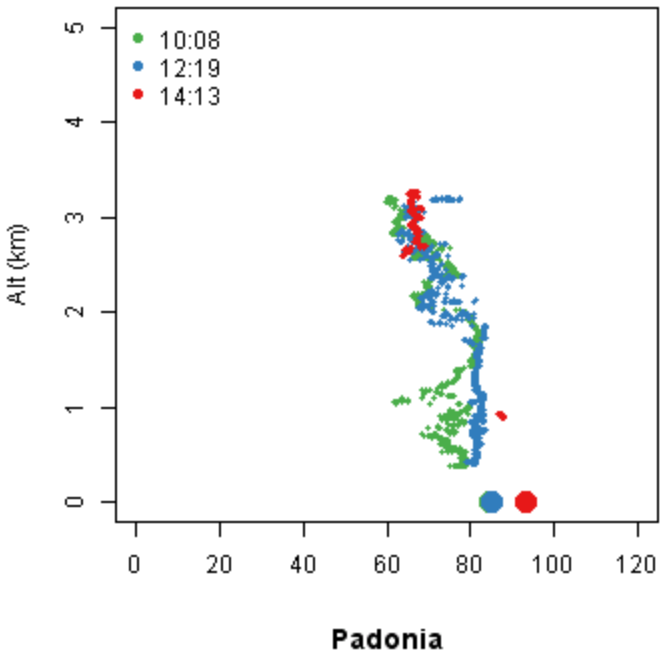
Essex → 87 ppb O_3 Code orange

Edgewood → 107 ppb O_3 Code red

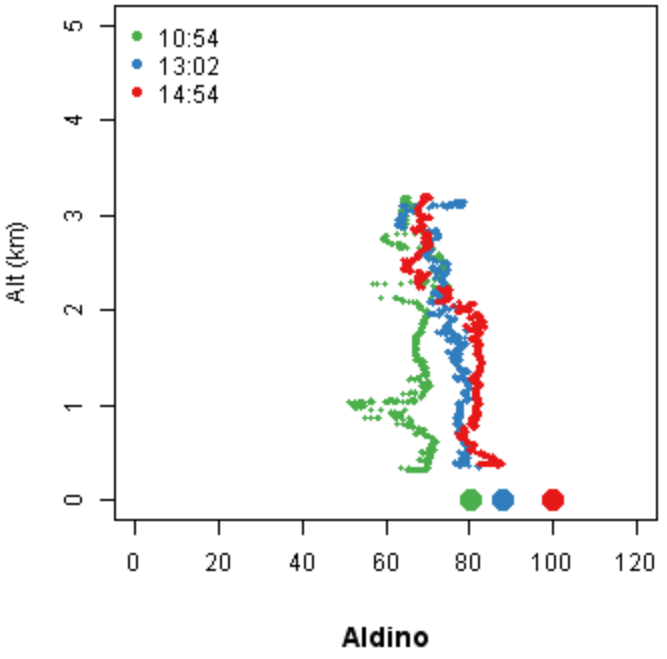
Time is EST

Bay breeze impacts Padonia -Aldino

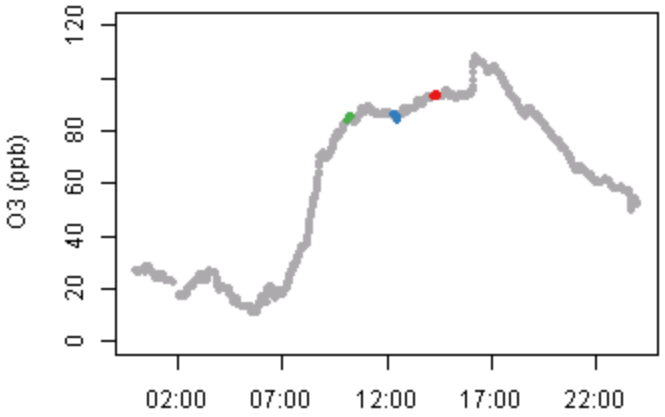




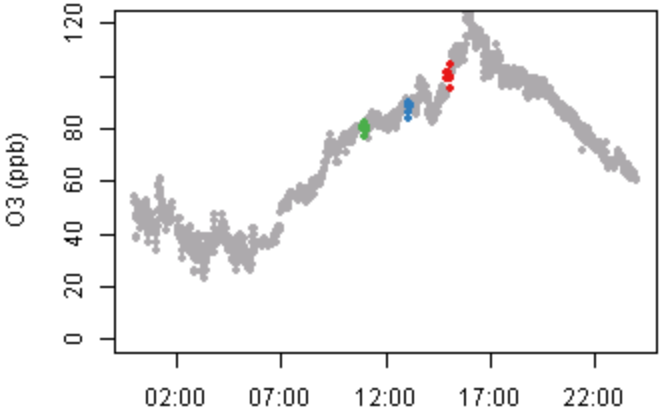
Padonia



Aldino



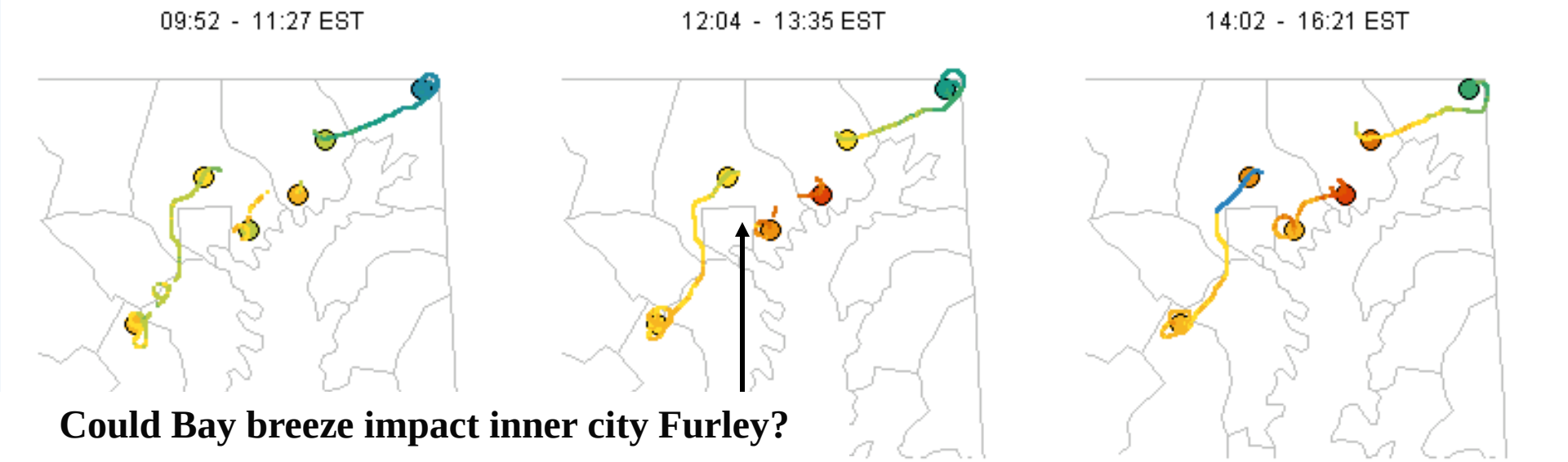
Padonia→ **92** ppb O_3 Code orange



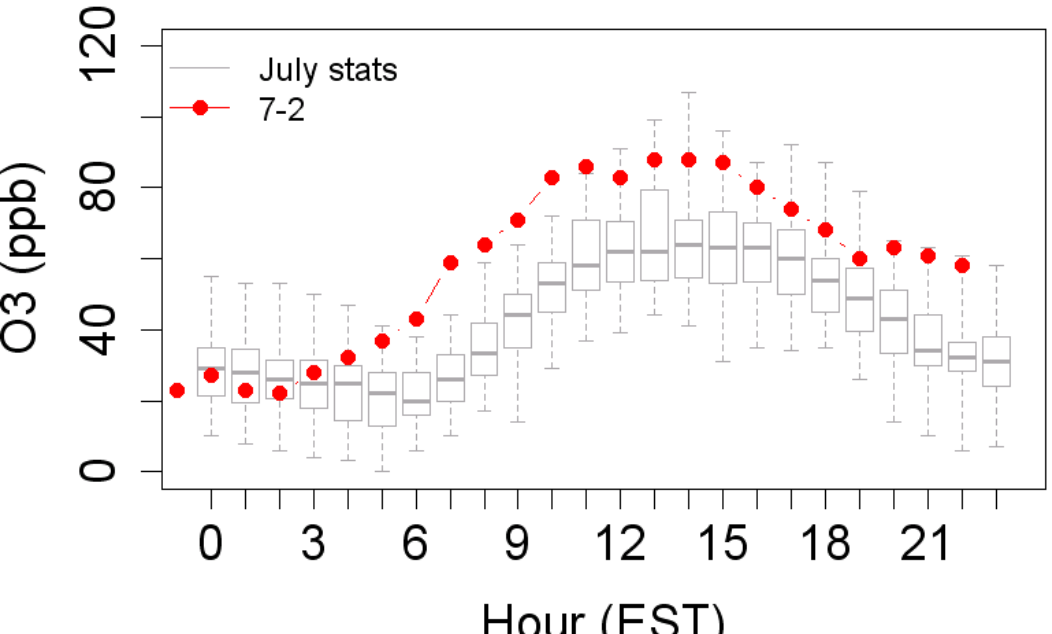
Aldino → **98** ppb O_3 Code red

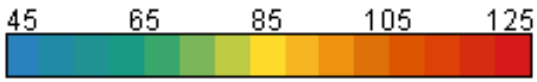
Time is EST

O_3 gradient in P3 transects



Could Bay breeze impact inner city Furley?





O_3 from P3 between 0.3 – 0.6 km

Surface O_3 circled in black.

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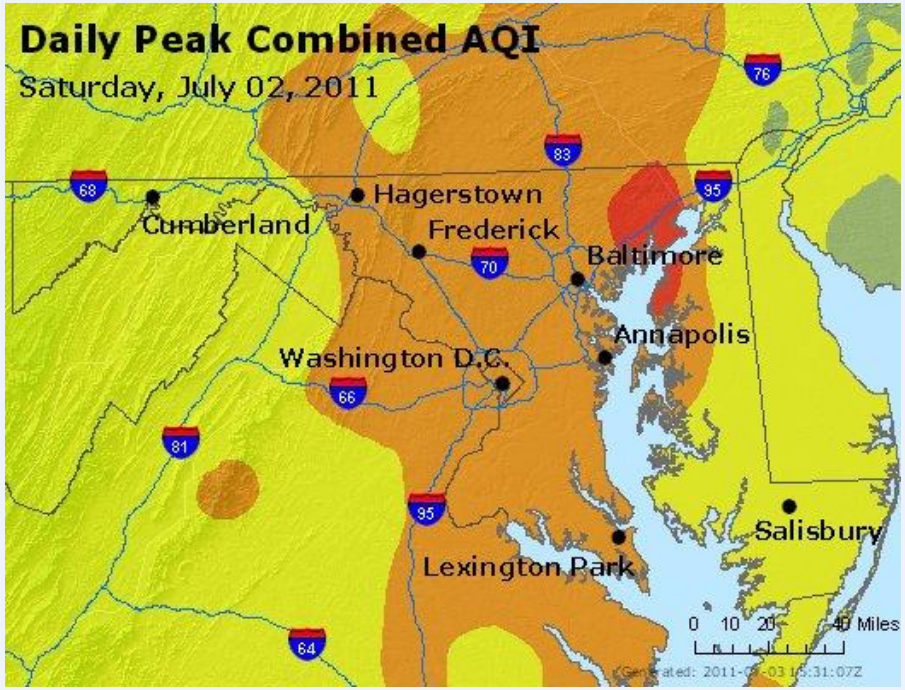
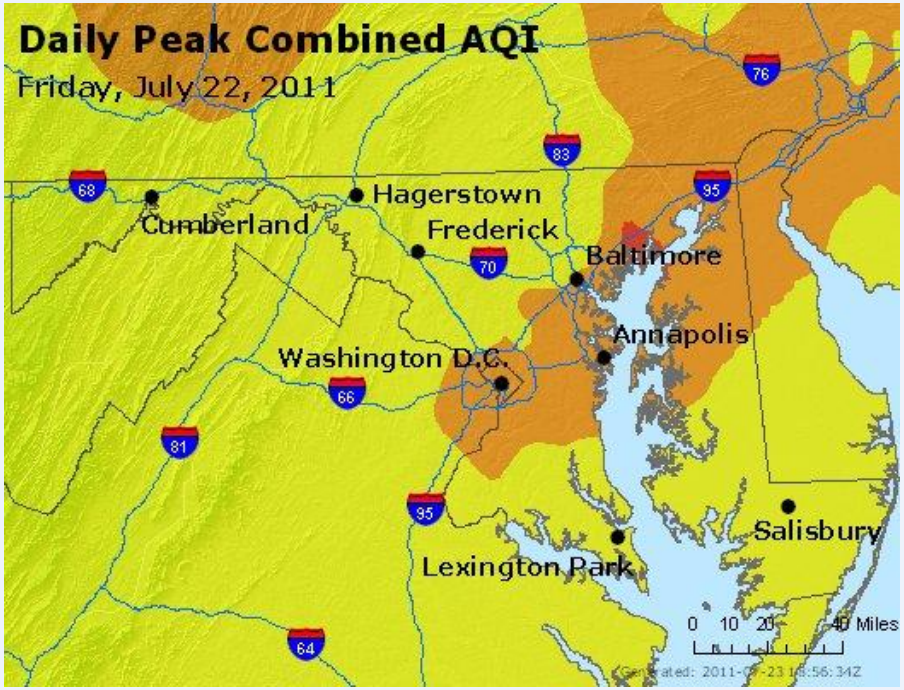
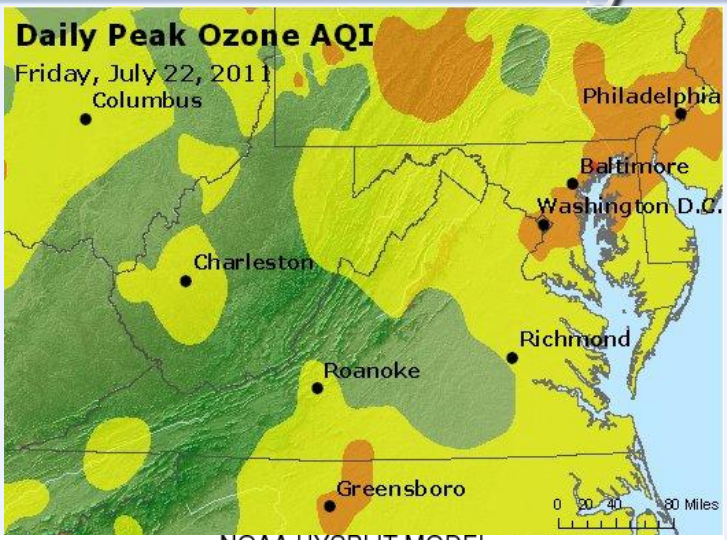
July 22, 2011



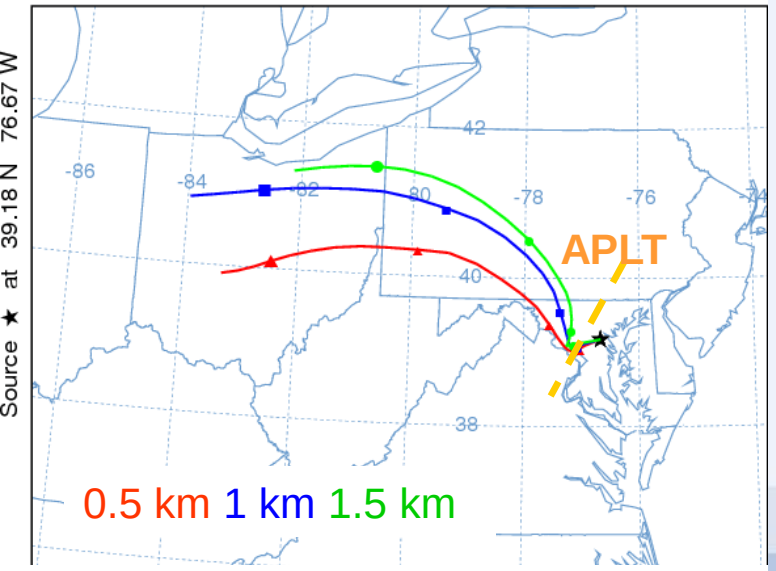


July 22- Code orange impacted a slightly smaller region than July 2.

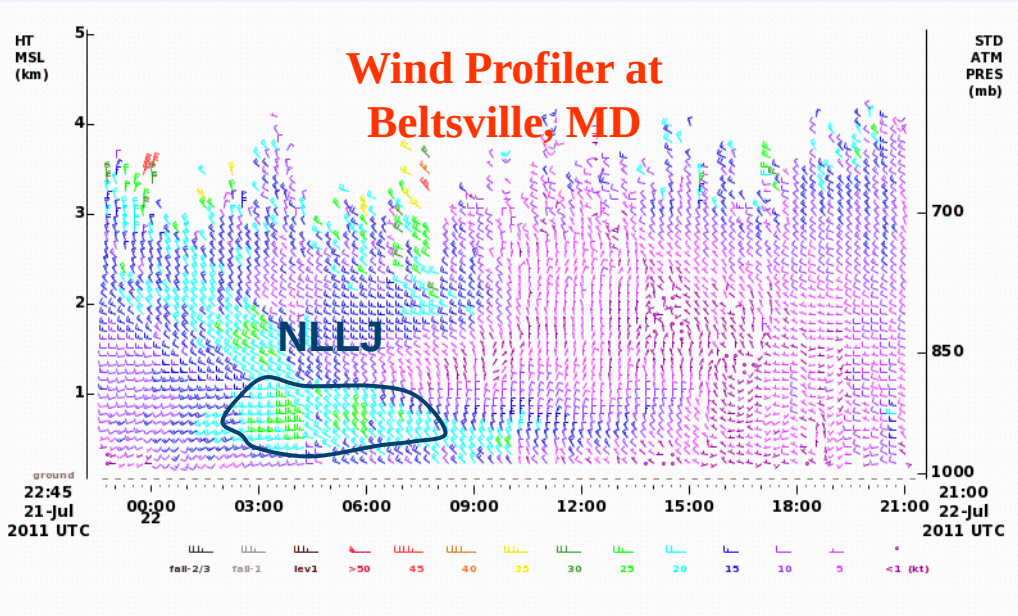
July 22 - Overview



NOAA HYSPLIT MODEL
Backward trajectories ending at 2100 UTC 22 Jul 11
NAM Meteorological Data

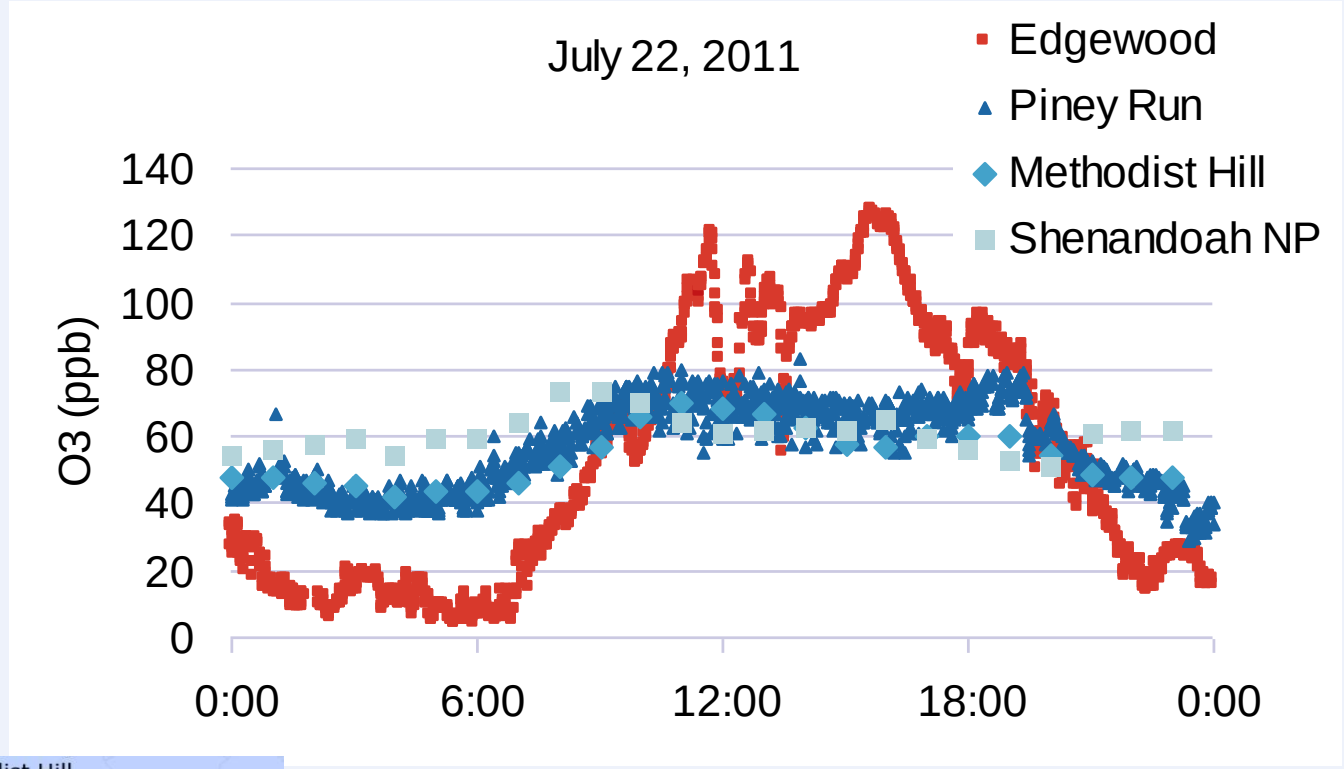


- Primary meteorological features
  - High pressure system off the coast.
  - Max. temperature @ BWI at 106 F.
  - NLLJ in the morning, stagnation in the afternoon.
  - Transport regime was primarily from the west to northwest.
  - An Appalachian Leeside Trough (APLT) near I95 corridor.



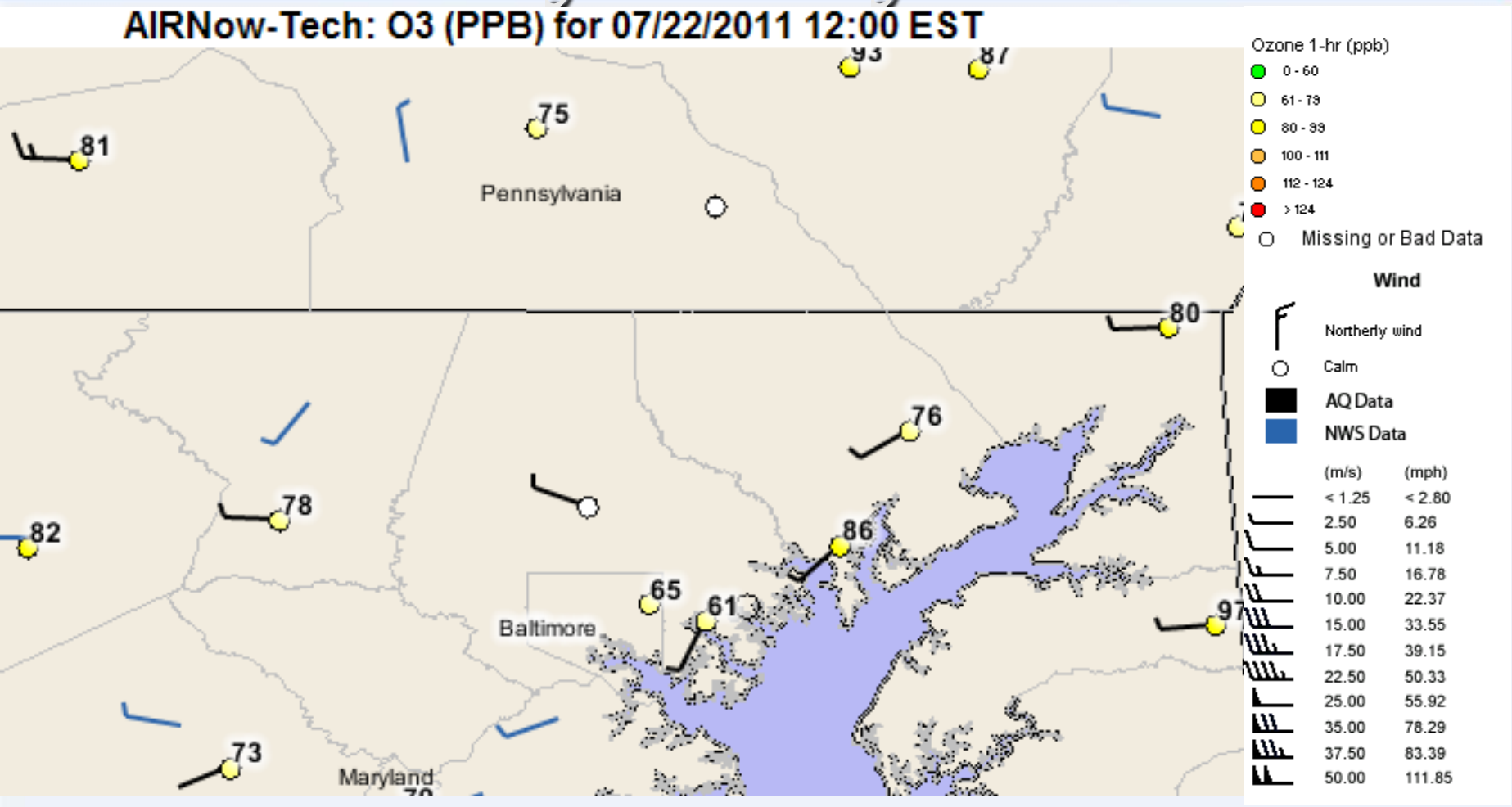
Sources: NOAA MADIS, NOAA ARL, Airnow

July 22- Transported O_3 into MD seen from Piney Run



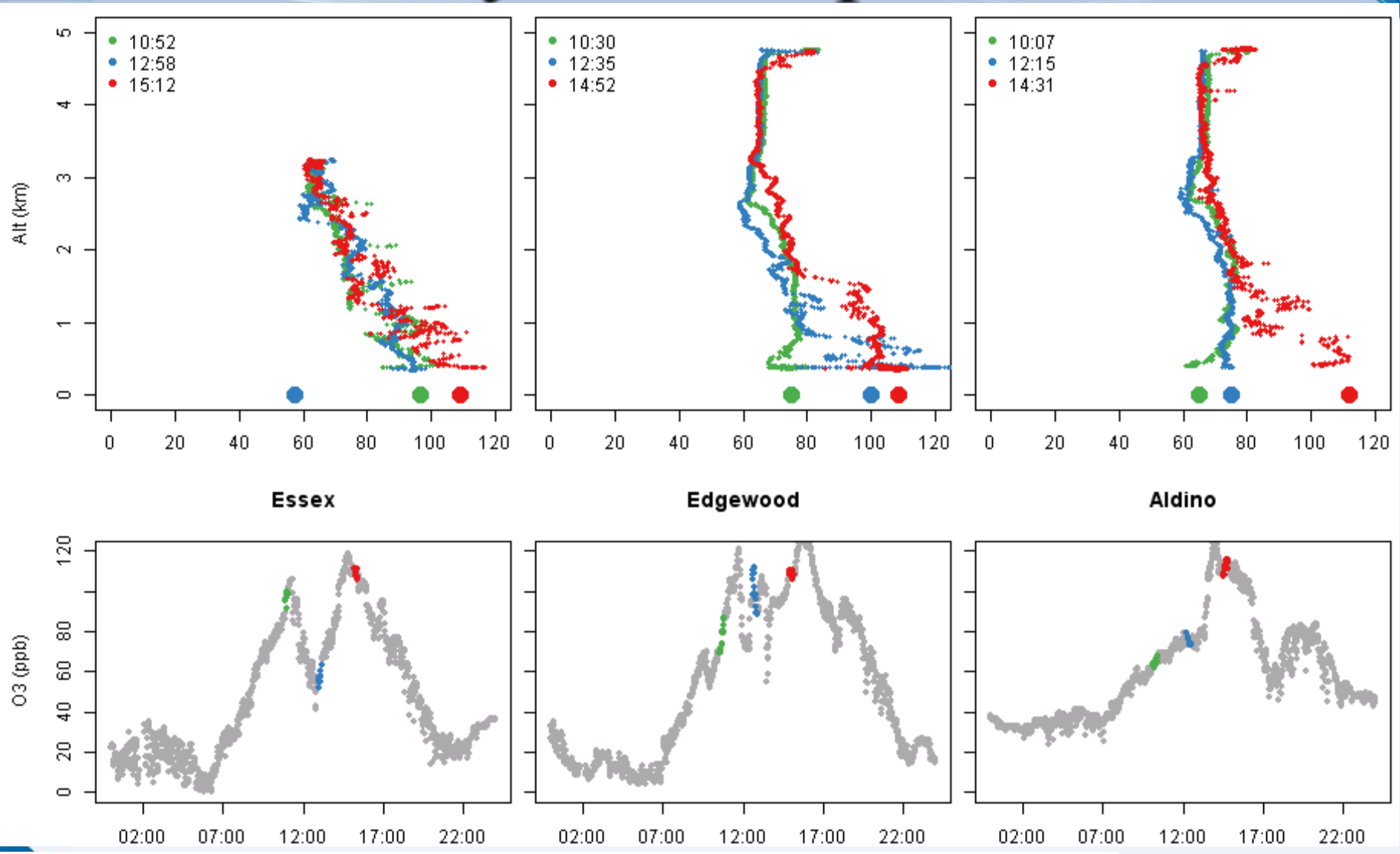
Morning O_3 (50 ppb) at Piney Run and other elevated sites may have been transported to the Baltimore area and then mixed down.

July 22 Bay breeze



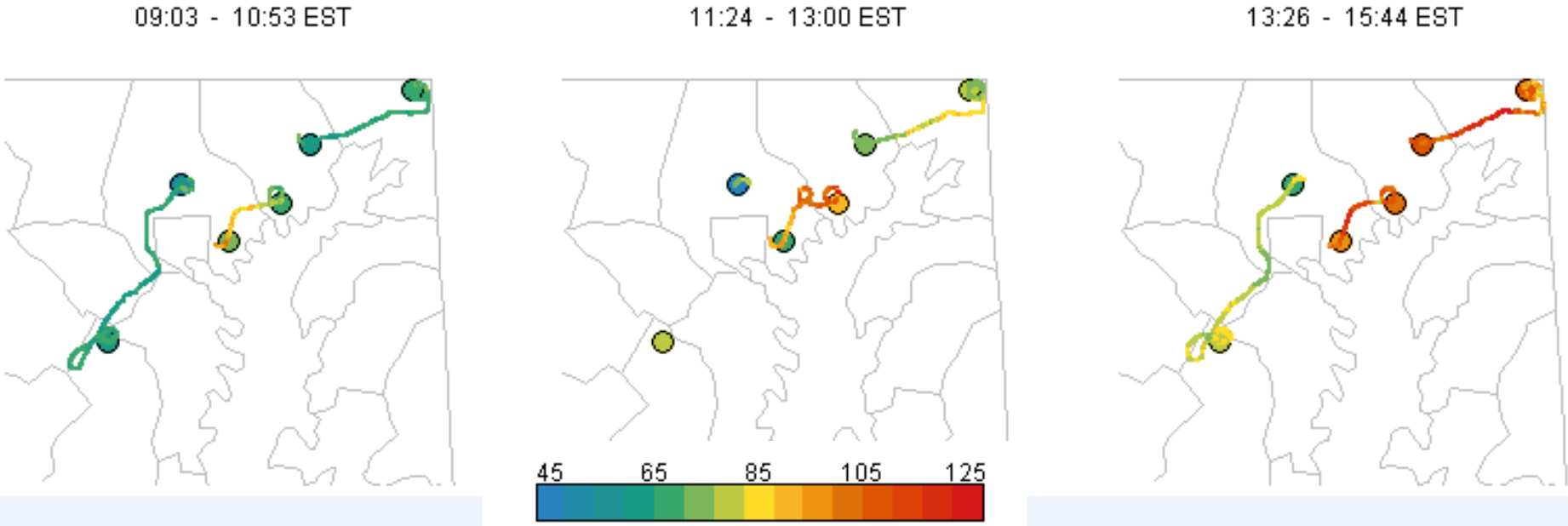
Surface winds show bay breeze between Essex and Padonia.

July 22- P3 profiles



- Morning elevated O_3 may have mixed down by the afternoon.
- Sharp O_3 decrease at noon (Essex, Edgewood).

July 22 P3 transects



O_3 from P3 only between 0.3-0.6 km

Surface O_3 circled in black.

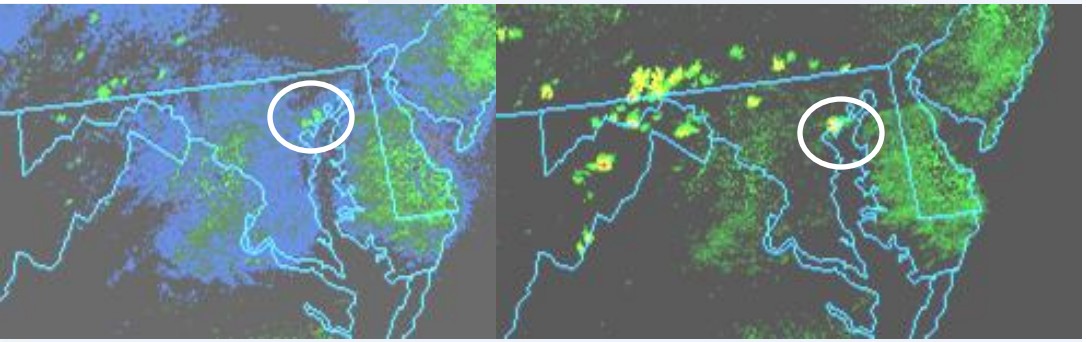
Morning elevated O_3 above Essex and Edgewood may have mixed down by afternoon.

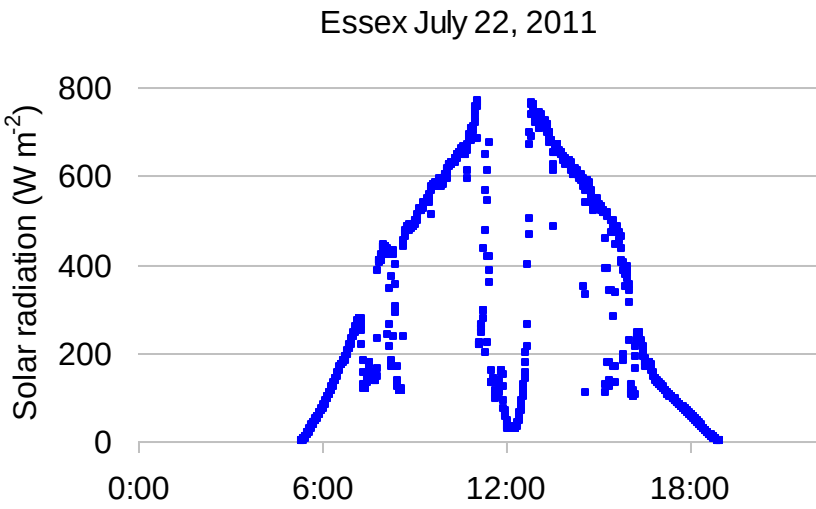
July 22 - Thunderstorms

NEXRAD 1km

1130 EST

1230 EST





- Bay breeze at Essex may have been the trigger for thunderstorms early in the day.
- Thunderstorm activity 1130-1230 EST.
  - Storm cells appear to extend to Edgewood.
  - Cloud cover blocked out sun and stalled O_3 formation.
  - Dissipated just before 13 EST.
- Once clouds cleared…
  - The bay breeze formed again near Essex.
  - O_3 was able to recover and reach high values later in the day.

Courtesy: Laura Landry

Summary

- DISCOVER-AQ provided a wealth of data to examine O_3 exceedance days in Maryland.
- Aircraft, balloon and lidar observations help us understand pollution aloft and how pollution is transported into the region.
- We will continue to analyze the data and collaborate with nearby universities and federal agencies.

Contact

Jennifer Hains

Ambient Air Monitoring Program

Maryland Department of the Environment
jhains@mde.state.md.us

(410) 537-4027